FIG.1

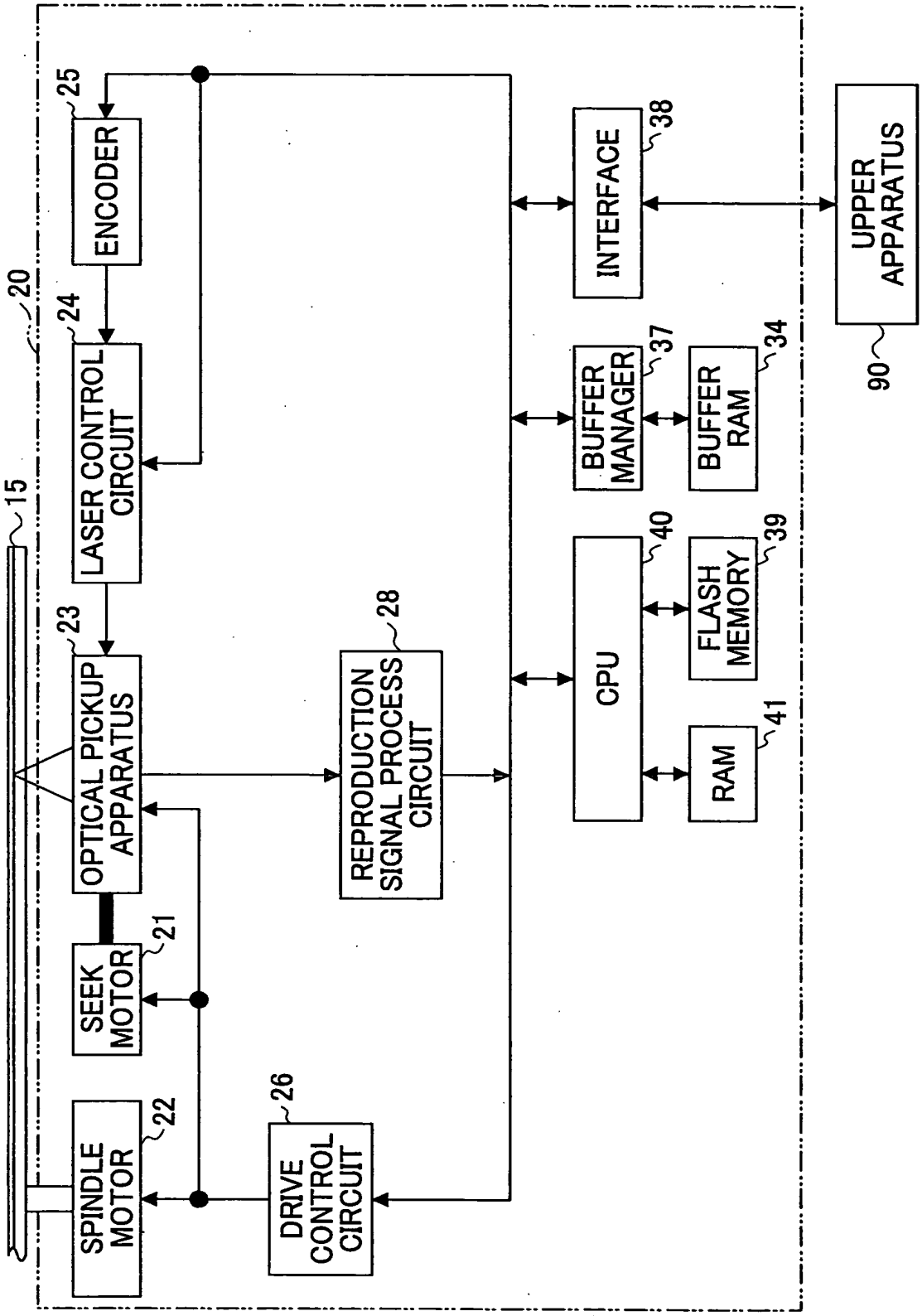

20
15
25
ENCODER
24
LASER CONTROL CIRCUIT
23
OPTICAL PICKUP APPARATUS
21
SEEK MOTOR
22
SPINDLE MOTOR
26
DRIVE CONTROL CIRCUIT
28
REPRODUCTION SIGNAL PROCESS CIRCUIT
38
INTERFACE
37
BUFFER MANAGER
34
BUFFER RAM
40
CPU
39
FLASH MEMORY
41
RAM
90
UPPER APPARATUS

FIG.2

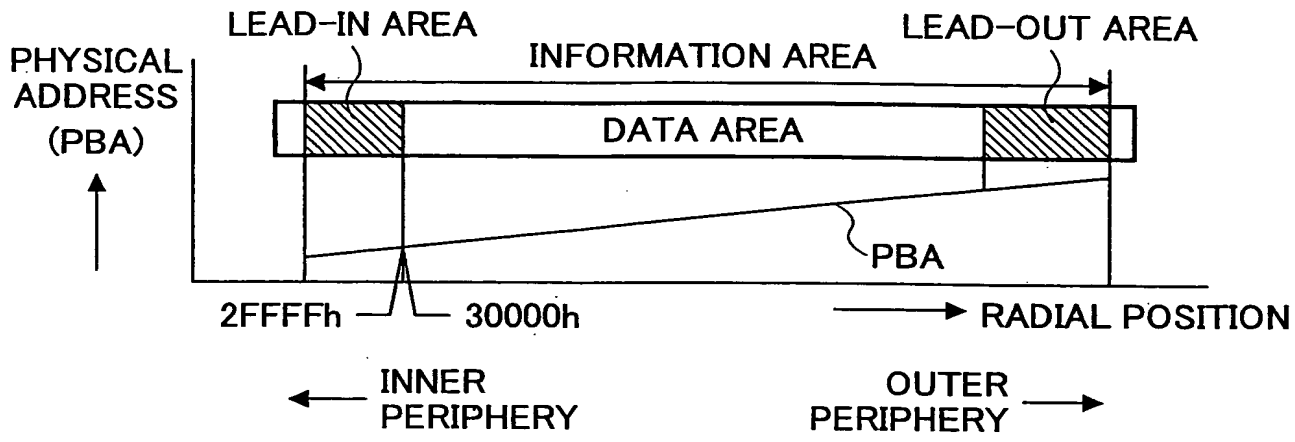

LEAD-IN AREA
INFORMATION AREA
LEAD-OUT AREA
PHYSICAL ADDRESS (PBA)
DATA AREA
PBA
2FFFFh
30000h
RADIAL POSITION
INNER PERIPHERY
OUTER PERIPHERY

FIG.3

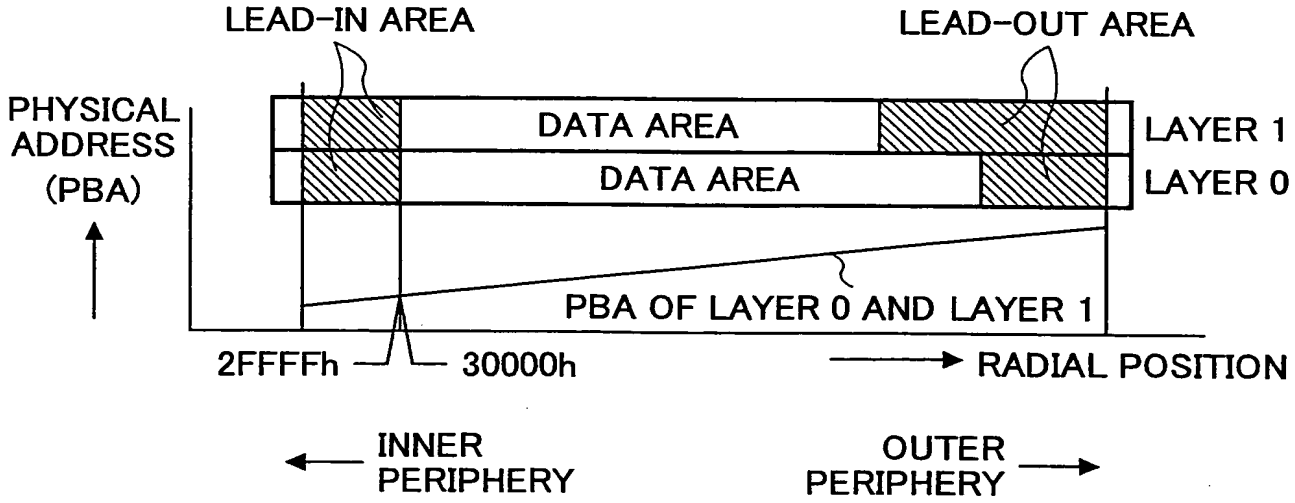

LEAD-IN AREA
LEAD-OUT AREA
PHYSICAL ADDRESS (PBA)
DATA AREA
LAYER 1
DATA AREA
LAYER 0
PBA OF LAYER 0 AND LAYER 1
2FFFFh
30000h
RADIAL POSITION
INNER PERIPHERY
OUTER PERIPHERY

FIG.4

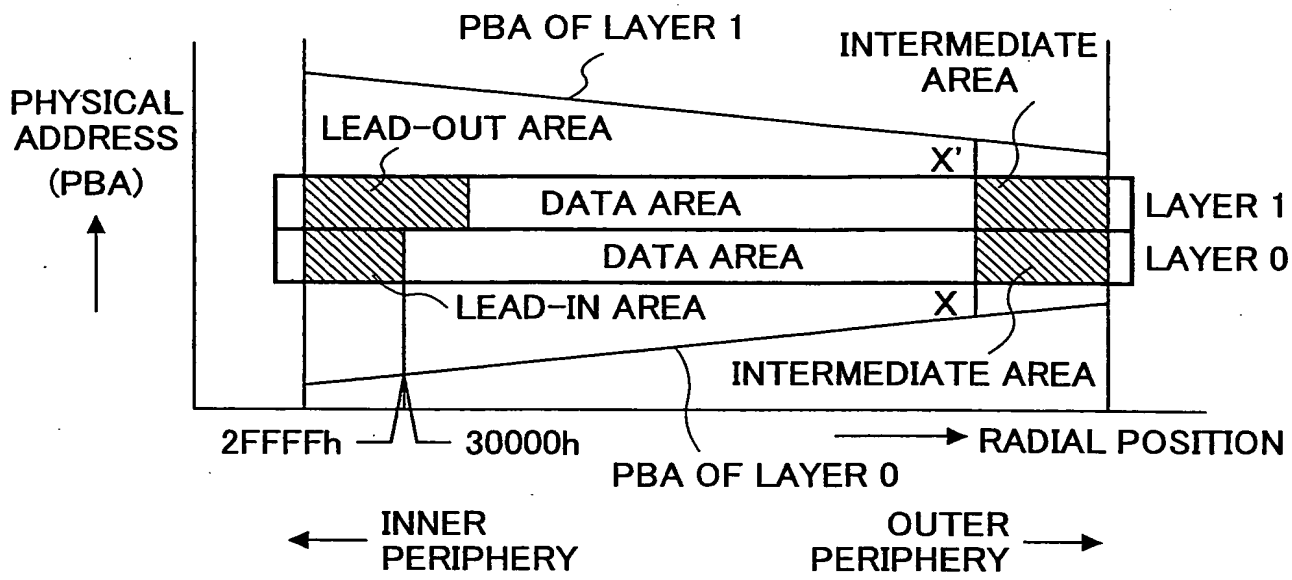

PBA OF LAYER 1
INTERMEDIATE AREA
PHYSICAL ADDRESS (PBA)
LEAD-OUT AREA
X'
DATA AREA
LAYER 1
DATA AREA
LAYER 0
LEAD-IN AREA
X
INTERMEDIATE AREA
2FFFFh
30000h
RADIAL POSITION
PBA OF LAYER 0
INNER PERIPHERY
OUTER PERIPHERY

FIG.5

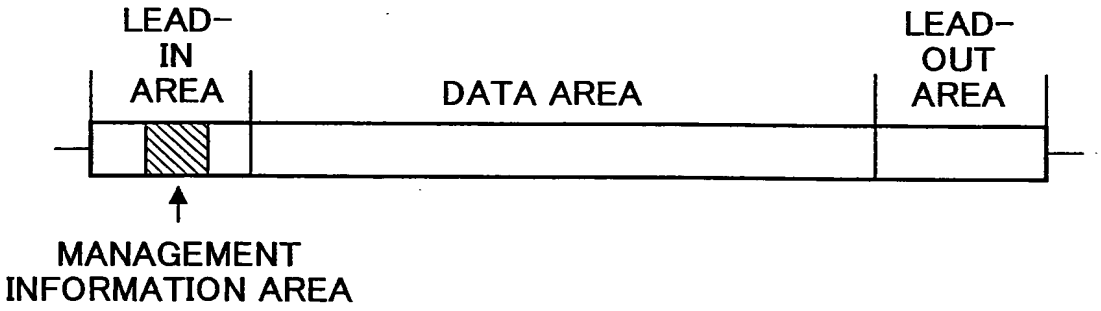

LEAD-IN AREA
DATA AREA
LEAD-OUT AREA
MANAGEMENT INFORMATION AREA

FIG.6A

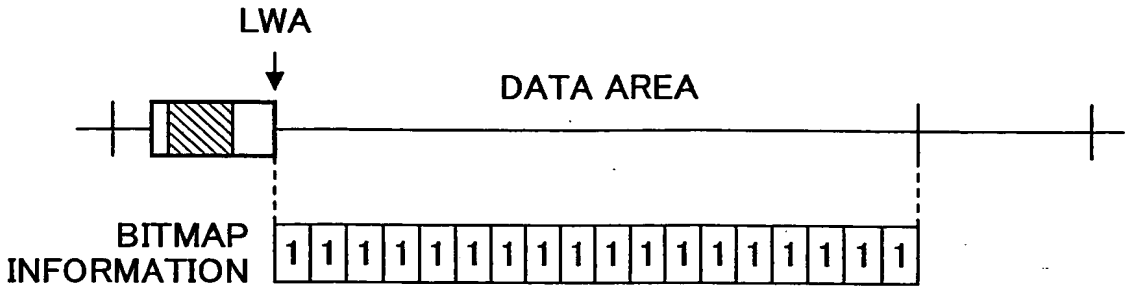


FIG.6B

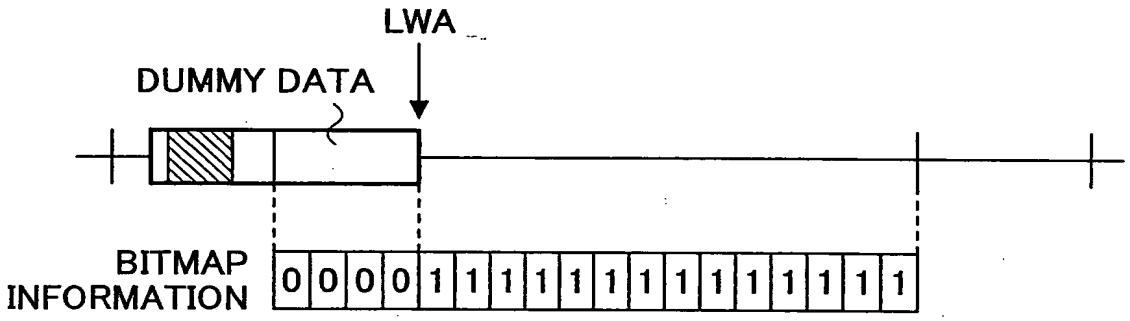


FIG.6C

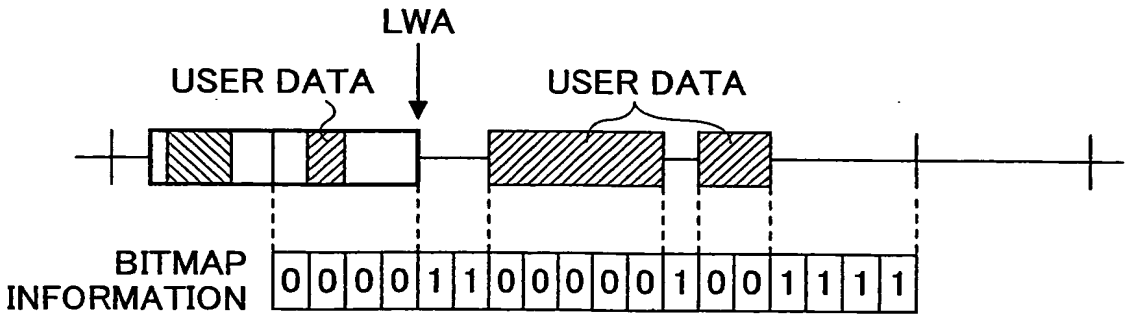


FIG.7A

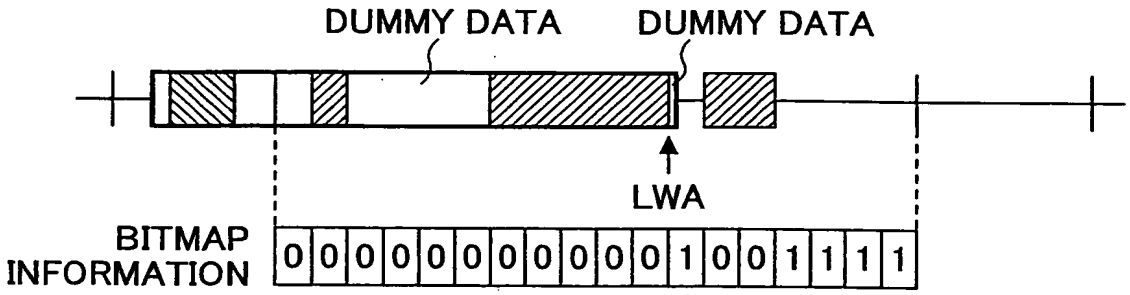


FIG.7B

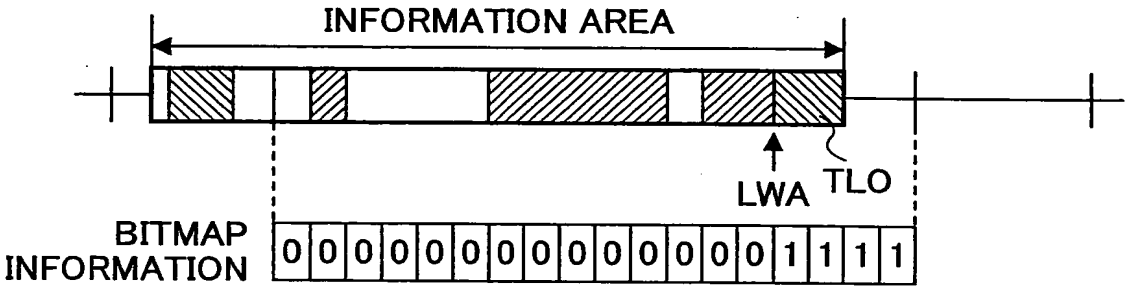


FIG.8

CONTENT	BYTE NUMBER
IDENTIFICATION ID	4
RESTRICTION INFORMATION FOR UNKNOWN IDENTIFICATION ID	4
DRIVE ID	32
UPDATE COUNT	4
FORMAT STATUS	4
LAST WRITTEN ADDRESS (LWA)	4
LAST VERIFIED ADDRESS (LVA)	4
BITMAP START ADDRESS	4
BITMAP LENGTH	4
DISC ID	32
RESERVATION	–
BITMAP	9 × 2048
RESERVATION	–

FIG.9

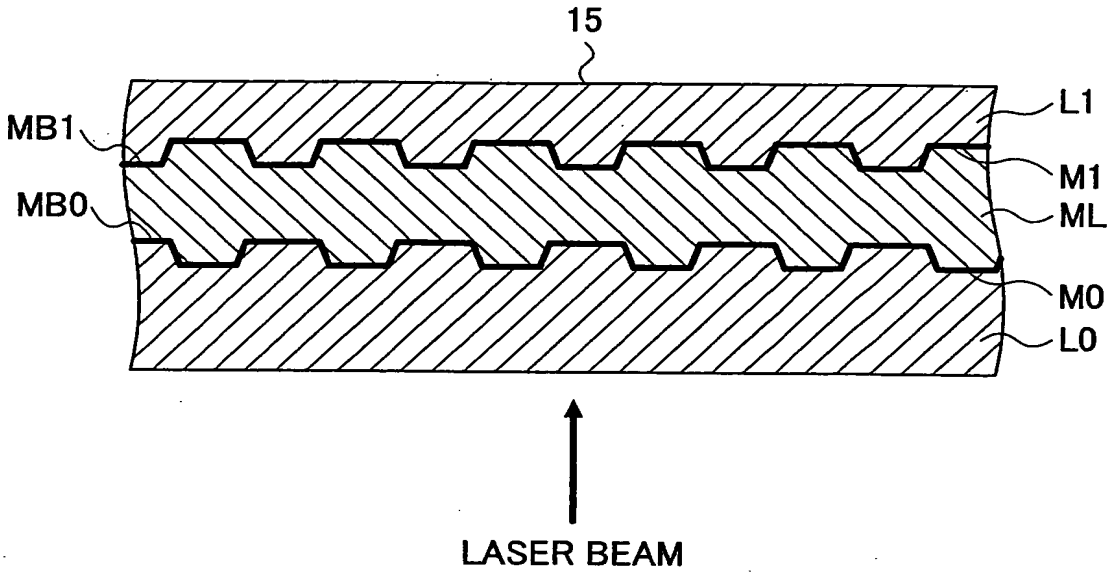

15
MB1
MB0
L1
M1
ML
M0
L0
LASER BEAM

FIG.10

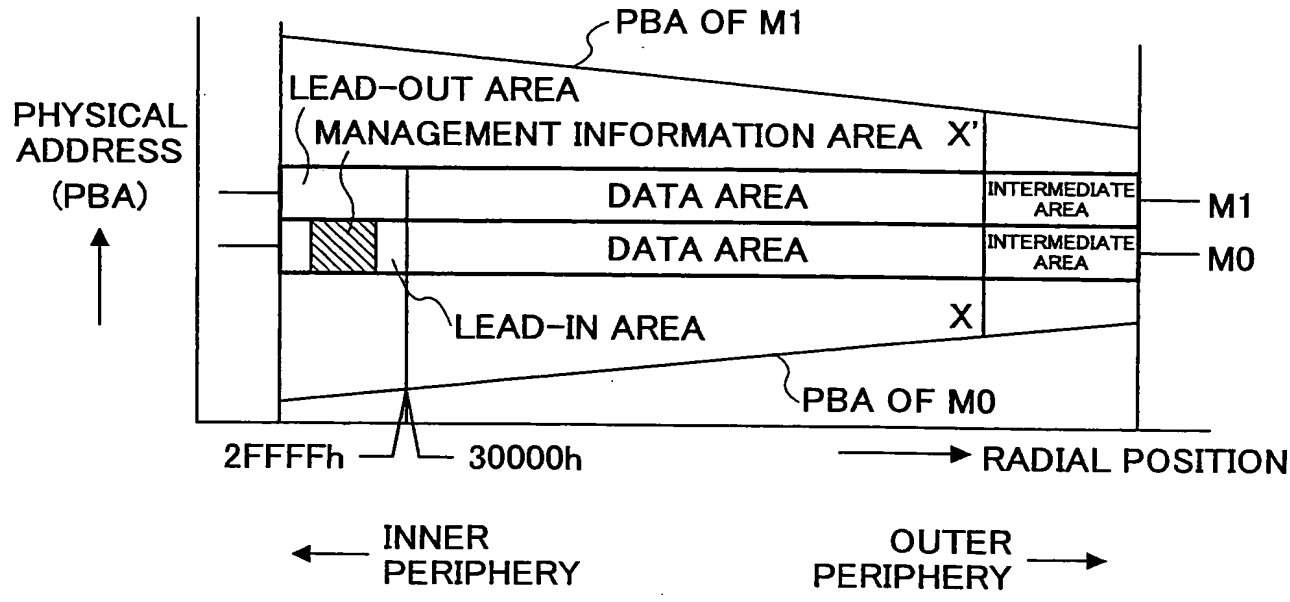

PBA OF M1
LEAD-OUT AREA
MANAGEMENT INFORMATION AREA
X'
PHYSICAL ADDRESS (PBA)
DATA AREA
INTERMEDIATE AREA
M1
DATA AREA
INTERMEDIATE AREA
M0
LEAD-IN AREA
X
PBA OF M0
2FFFFh
30000h
RADIAL POSITION
INNER PERIPHERY
OUTER PERIPHERY

FIG.11

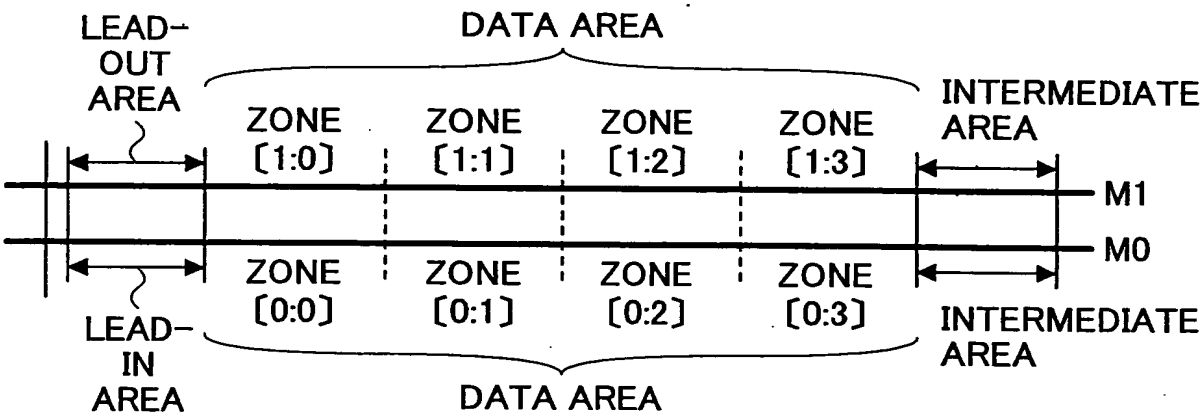


FIG.12

CONTENT	BYTE NUMBER
IDENTIFICATION ID	4
RESTRICTION INFORMATION FOR UNKNOWN IDENTIFICATION ID	4
DRIVE ID	32
UPDATE COUNT	4
FORMAT STATUS	4
LAST WRITTEN ADDRESS (LWA)	4
LAST VERIFIED ADDRESS (LVA)	4
BITMAP START ADDRESS	4
BITMAP LENGTH	4
DISC ID	32
LAST UNWRITTEN ADDRESS (LUA)	4
ZONE LAST WRITTEN ADDRESS (ZONE LWA)	4
RESERVATION	–
BITMAP	9×2048
RESERVATION	–

FIG.13

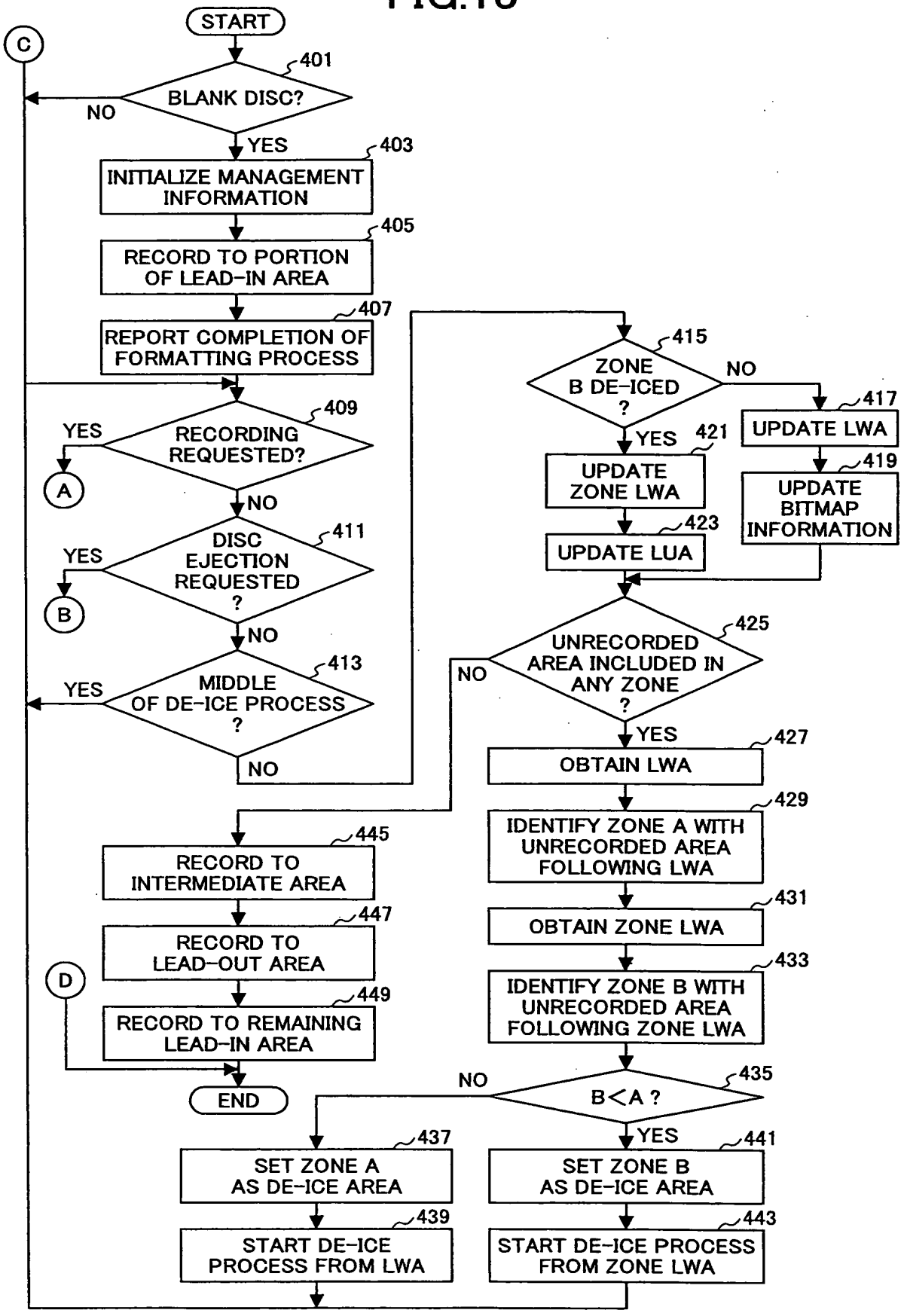

START
C
401
BLANK DISC?
NO
YES
403
INITIALIZE MANAGEMENT INFORMATION
405
RECORD TO PORTION OF LEAD-IN AREA
407
REPORT COMPLETION OF FORMATTING PROCESS
409
RECORDING REQUESTED?
YES
A
NO
411
DISC EJECTION REQUESTED ?
YES
B
NO
413
MIDDLE OF DE-ICE PROCESS ?
YES
NO
415
ZONE B DE-ICED ?
NO
YES
417
UPDATE LWA
419
UPDATE BITMAP INFORMATION
421
UPDATE ZONE LWA
423
UPDATE LUA
425
UNRECORDED AREA INCLUDED IN ANY ZONE ?
NO
YES
427
OBTAIN LWA
429
IDENTIFY ZONE A WITH UNRECORDED AREA FOLLOWING LWA
431
OBTAIN ZONE LWA
433
IDENTIFY ZONE B WITH UNRECORDED AREA FOLLOWING ZONE LWA
435
B<A ?
NO
YES
437
SET ZONE A AS DE-ICE AREA
439
START DE-ICE PROCESS FROM LWA
441
SET ZONE B AS DE-ICE AREA
443
START DE-ICE PROCESS FROM ZONE LWA
445
RECORD TO INTERMEDIATE AREA
447
RECORD TO LEAD-OUT AREA
D
449
RECORD TO REMAINING LEAD-IN AREA
END

FIG.14A

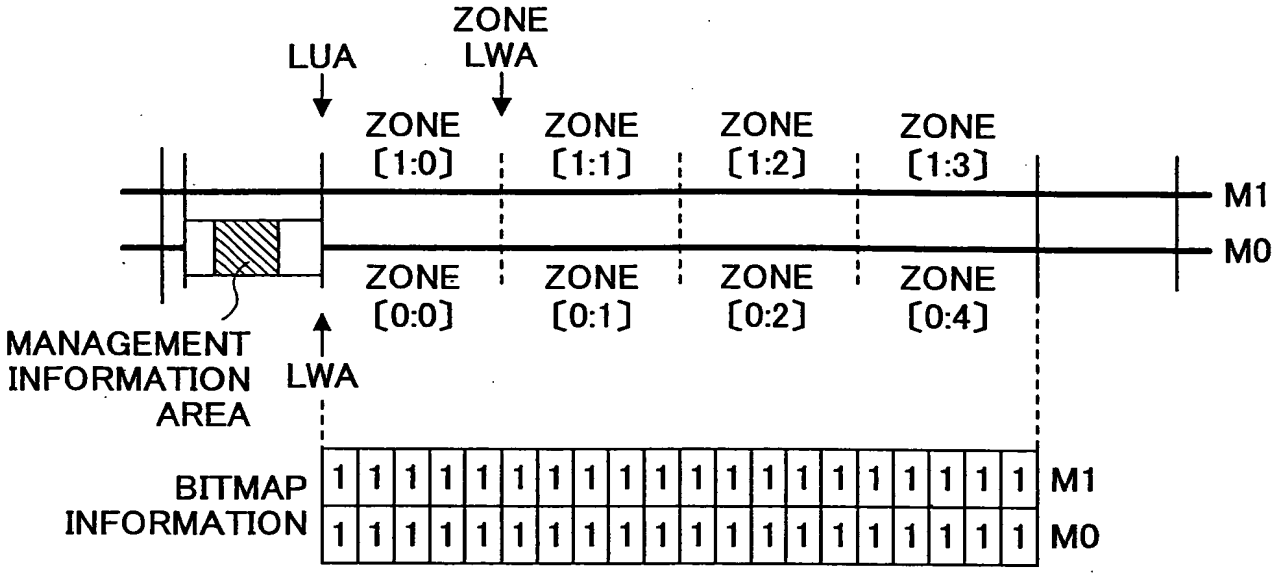


FIG.14B

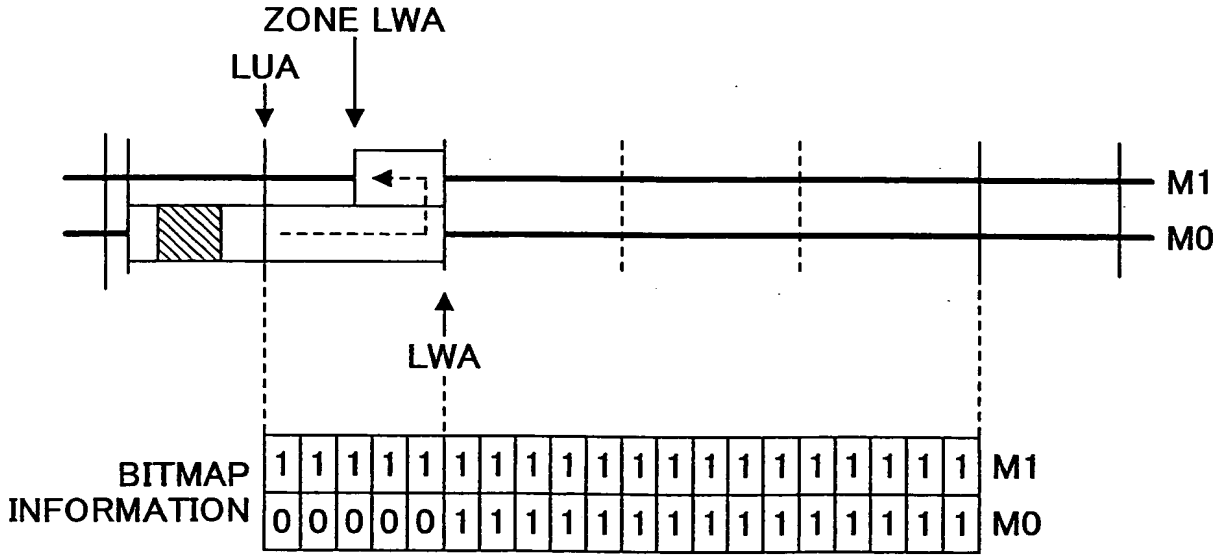


FIG.14C

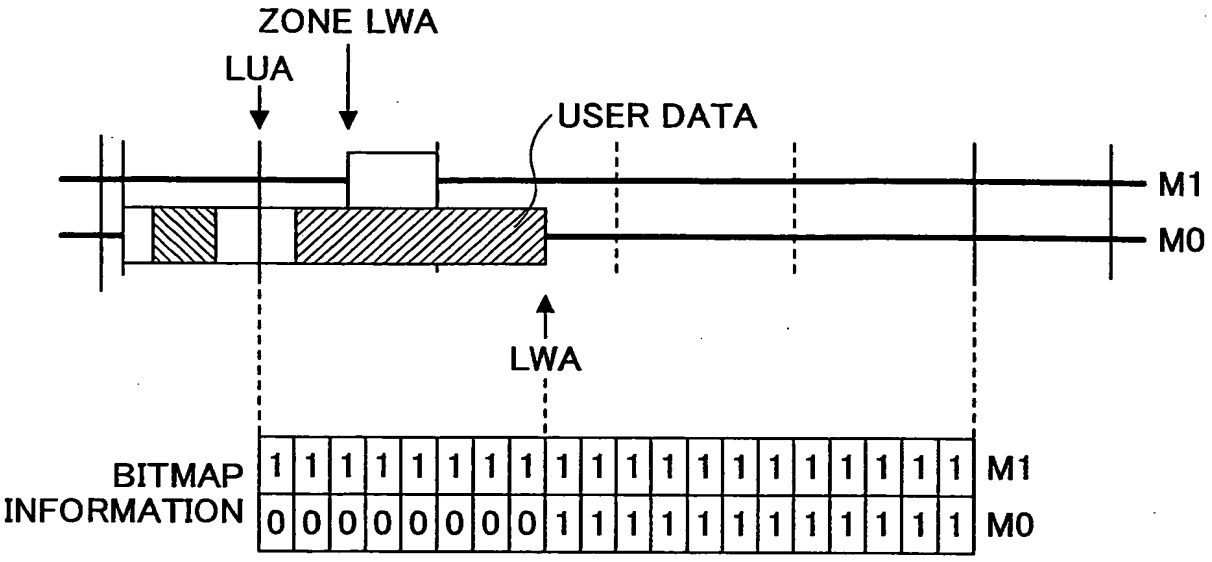


FIG.15A

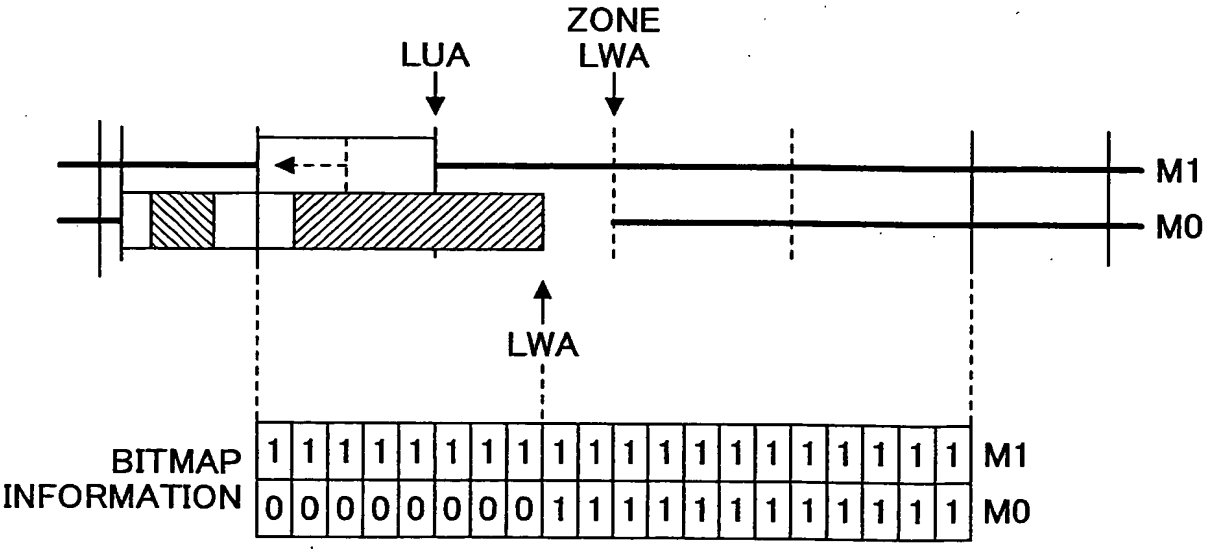


FIG.15B

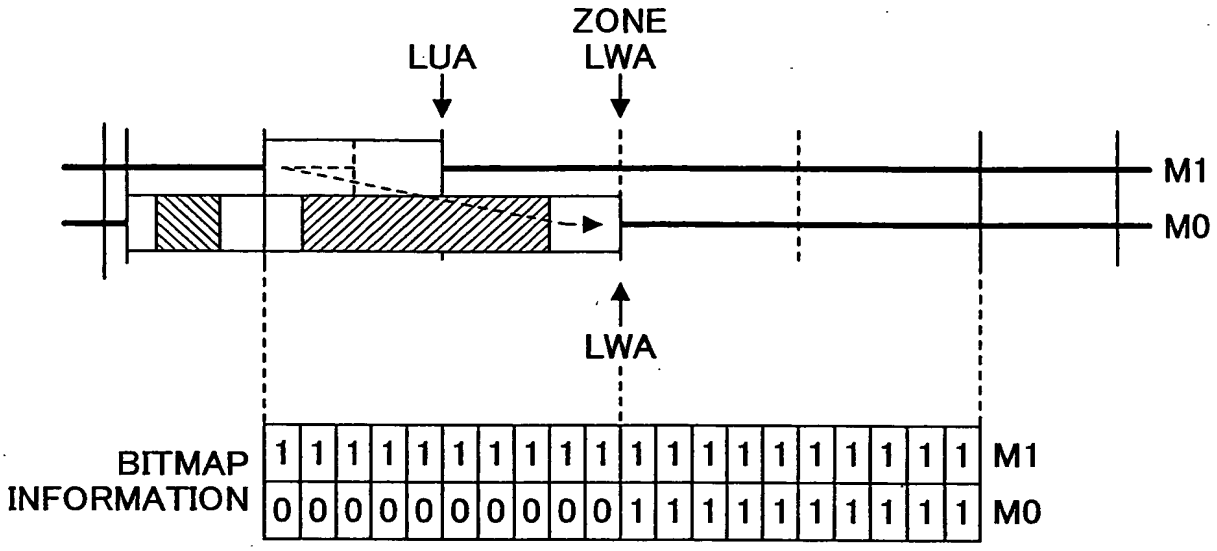


FIG.15C

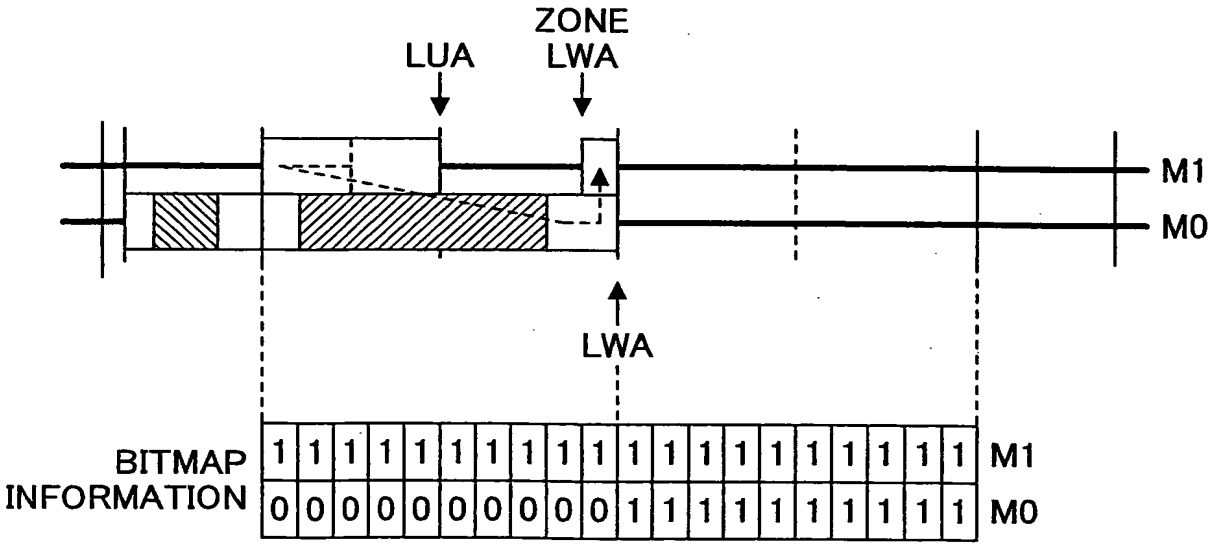


FIG.16

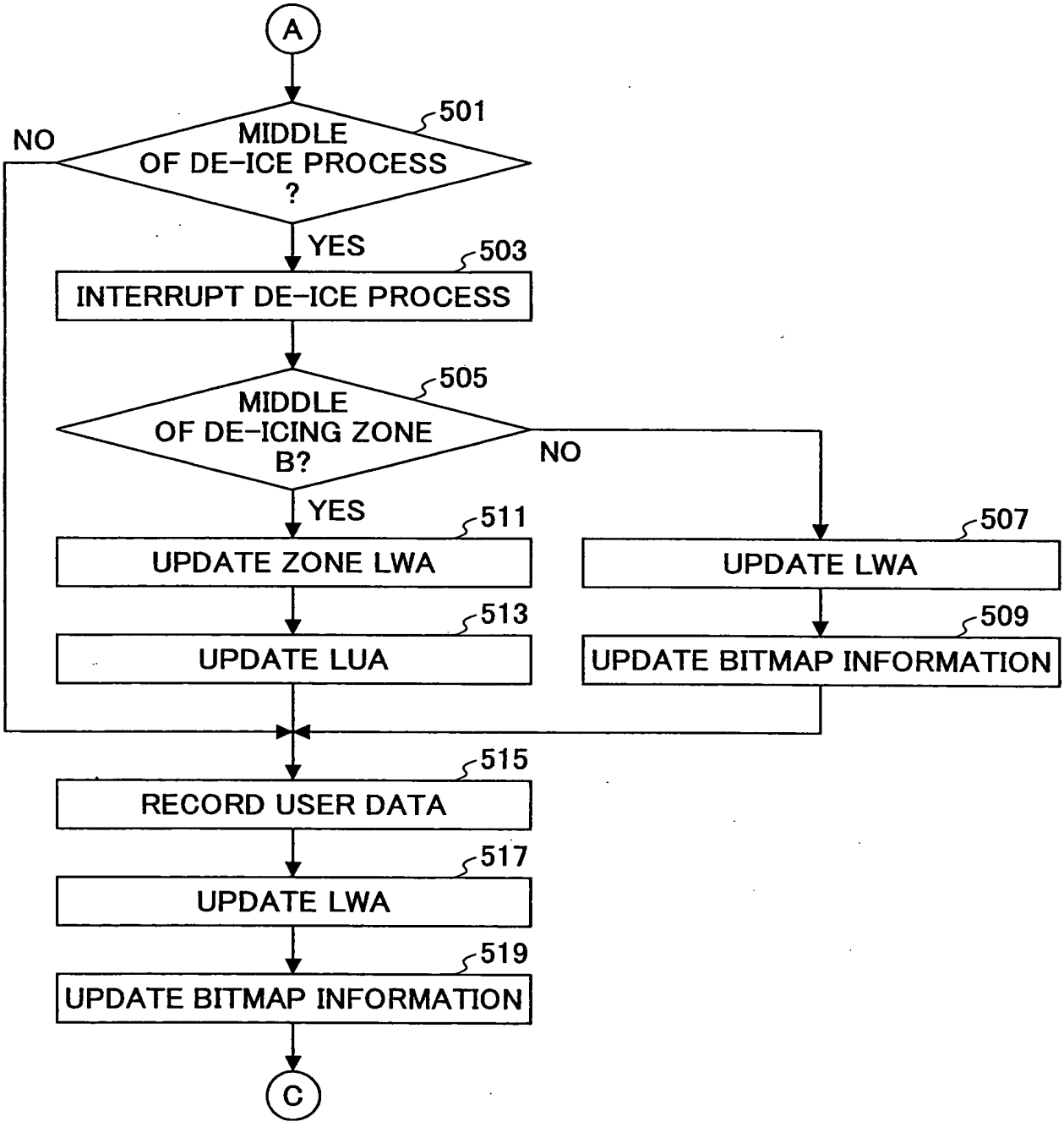

A
501
MIDDLE OF DE-ICE PROCESS ?
NO
YES
503
INTERRUPT DE-ICE PROCESS
505
MIDDLE OF DE-ICING ZONE B?
NO
YES
511
UPDATE ZONE LWA
513
UPDATE LUA
507
UPDATE LWA
509
UPDATE BITMAP INFORMATION
515
RECORD USER DATA
517
UPDATE LWA
519
UPDATE BITMAP INFORMATION
C

FIG.17

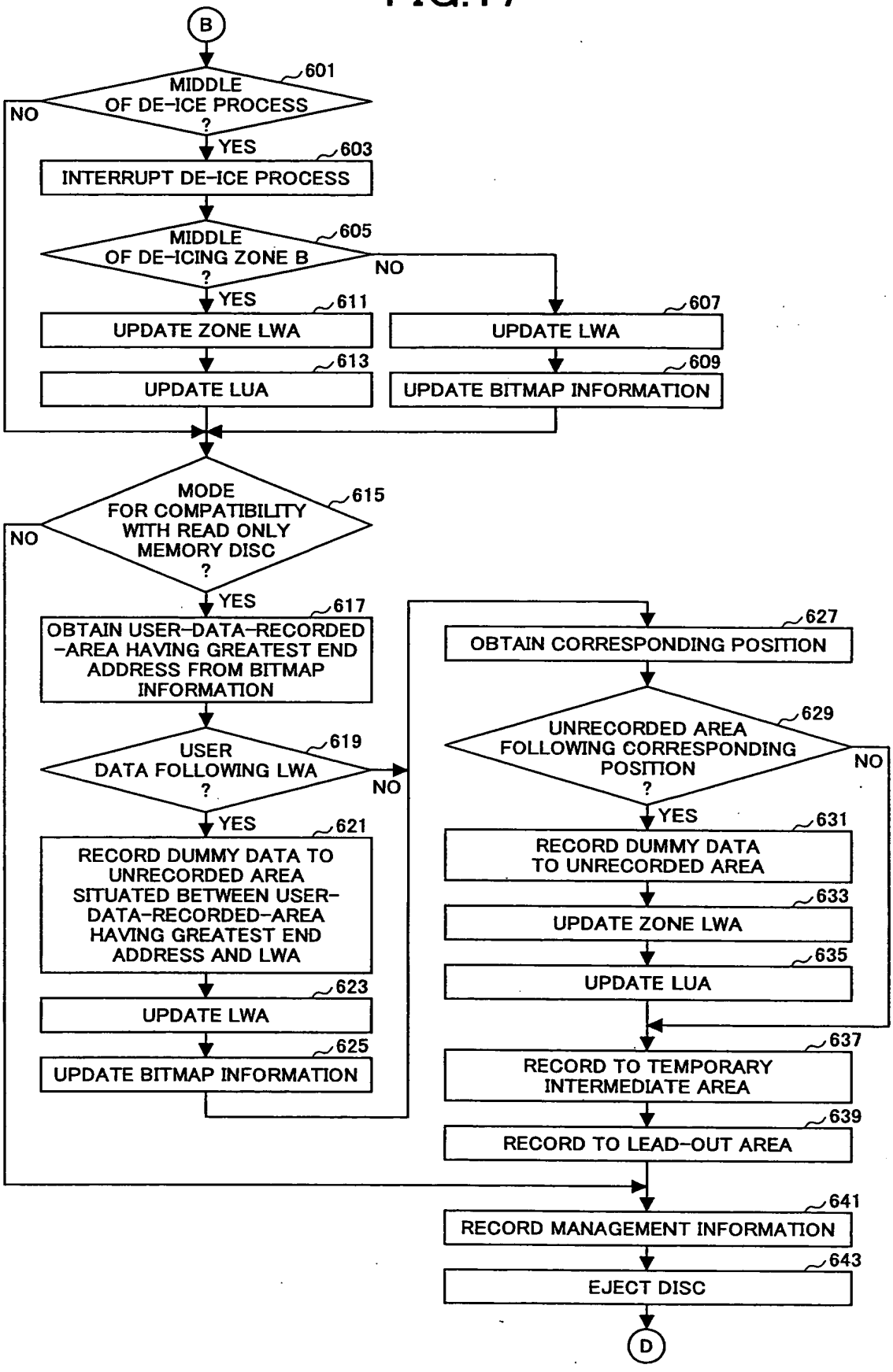

B
601
MIDDLE OF DE-ICE PROCESS ?
NO
YES
603
INTERRUPT DE-ICE PROCESS
605
MIDDLE OF DE-ICING ZONE B ?
NO
YES
611
UPDATE ZONE LWA
613
UPDATE LUA
607
UPDATE LWA
609
UPDATE BITMAP INFORMATION
615
MODE FOR COMPATIBILITY WITH READ ONLY MEMORY DISC ?
NO
YES
617
OBTAIN USER-DATA-RECORDED-AREA HAVING GREATEST END ADDRESS FROM BITMAP INFORMATION
619
USER DATA FOLLOWING LWA ?
NO
YES
621
RECORD DUMMY DATA TO UNRECORDED AREA SITUATED BETWEEN USER-DATA-RECORDED-AREA HAVING GREATEST END ADDRESS AND LWA
623
UPDATE LWA
625
UPDATE BITMAP INFORMATION
627
OBTAIN CORRESPONDING POSITION
629
UNRECORDED AREA FOLLOWING CORRESPONDING POSITION ?
NO
YES
631
RECORD DUMMY DATA TO UNRECORDED AREA
633
UPDATE ZONE LWA
635
UPDATE LUA
637
RECORD TO TEMPORARY INTERMEDIATE AREA
639
RECORD TO LEAD-OUT AREA
641
RECORD MANAGEMENT INFORMATION
643
EJECT DISC
D

FIG.18A

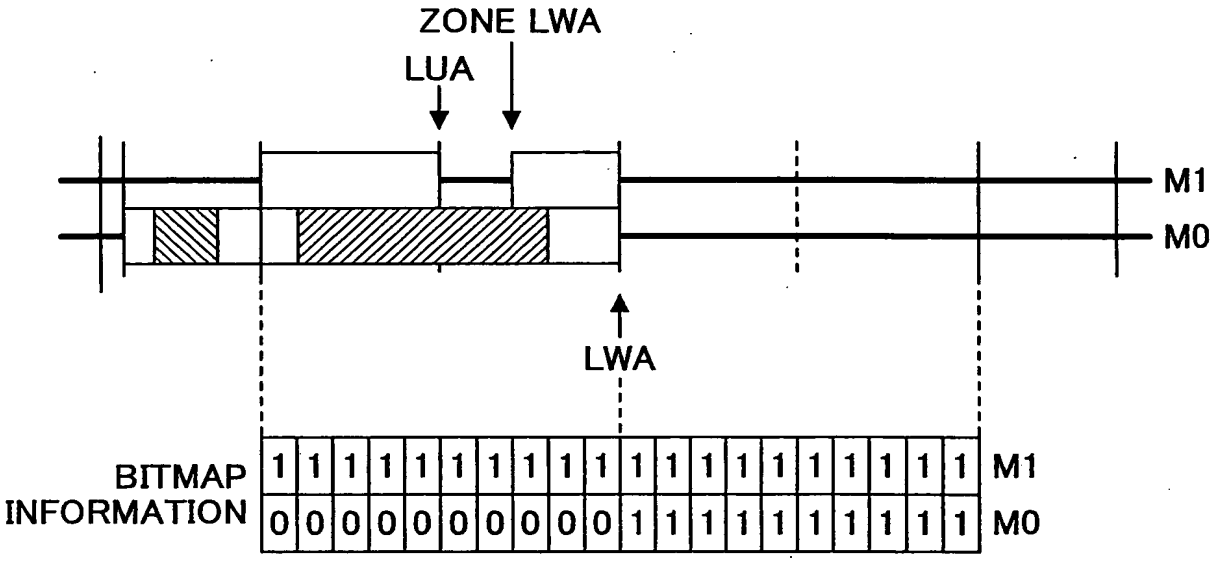


FIG.18B

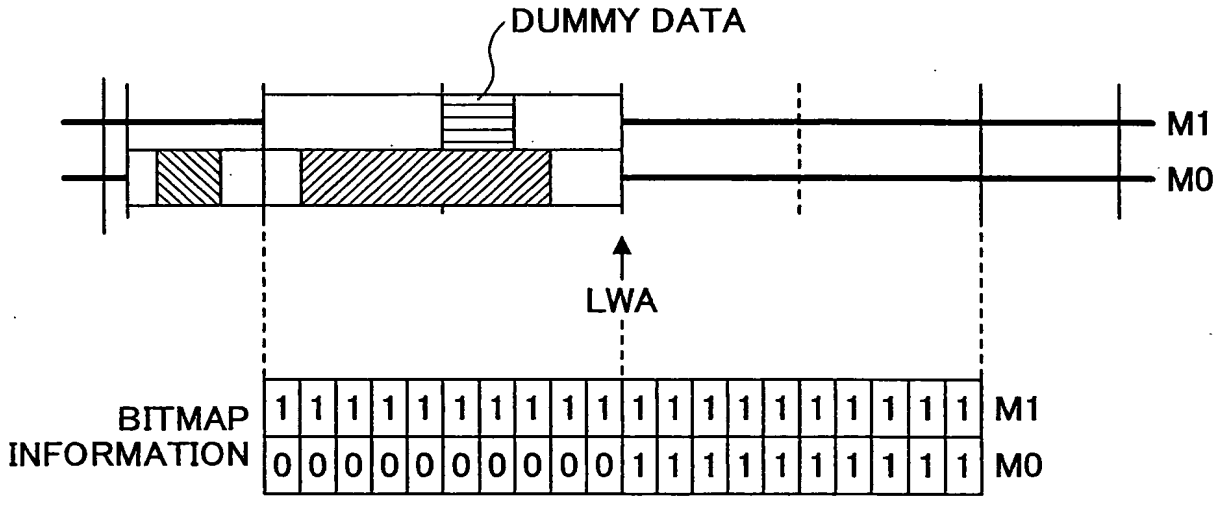


FIG.18C

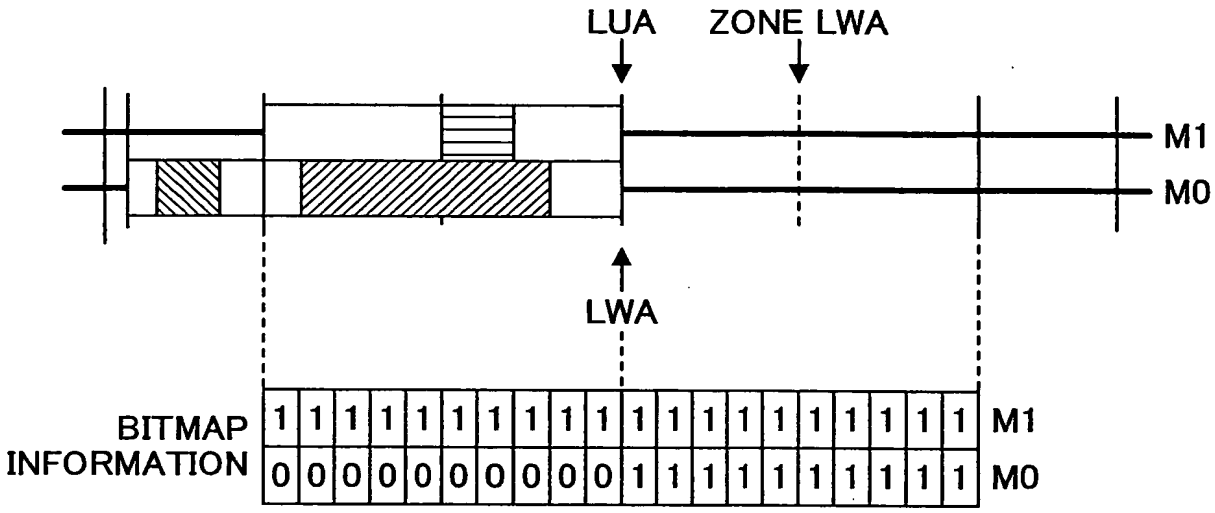

LUA
ZONE LWA
M1
M0
LWA
BITMAP INFORMATION
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 M1
0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 M0

FIG.19A

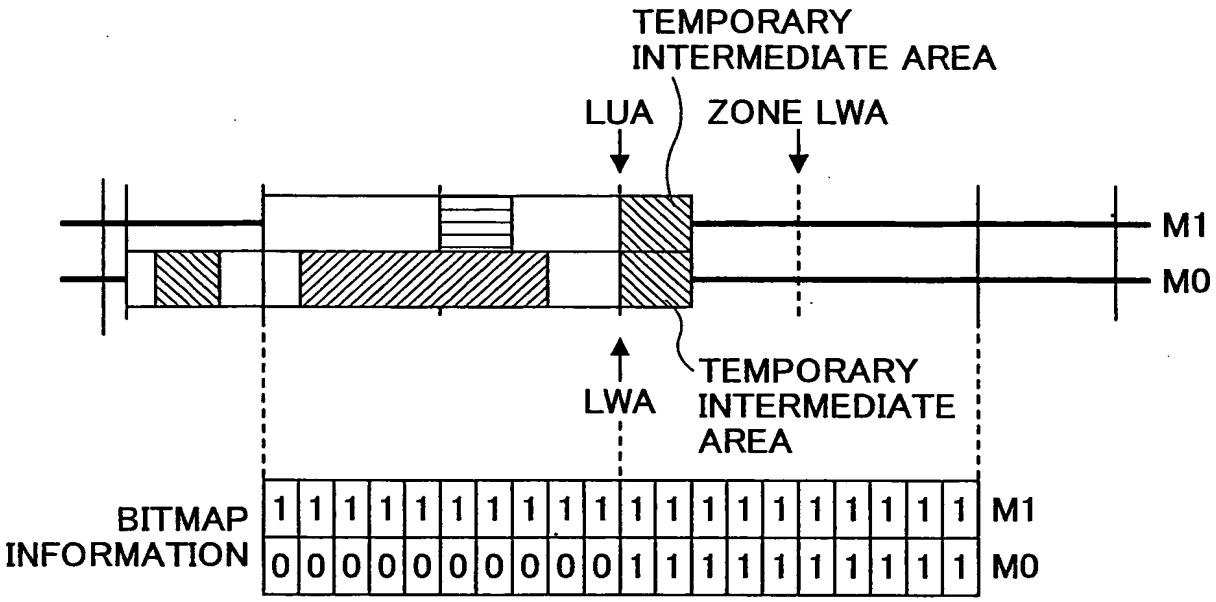
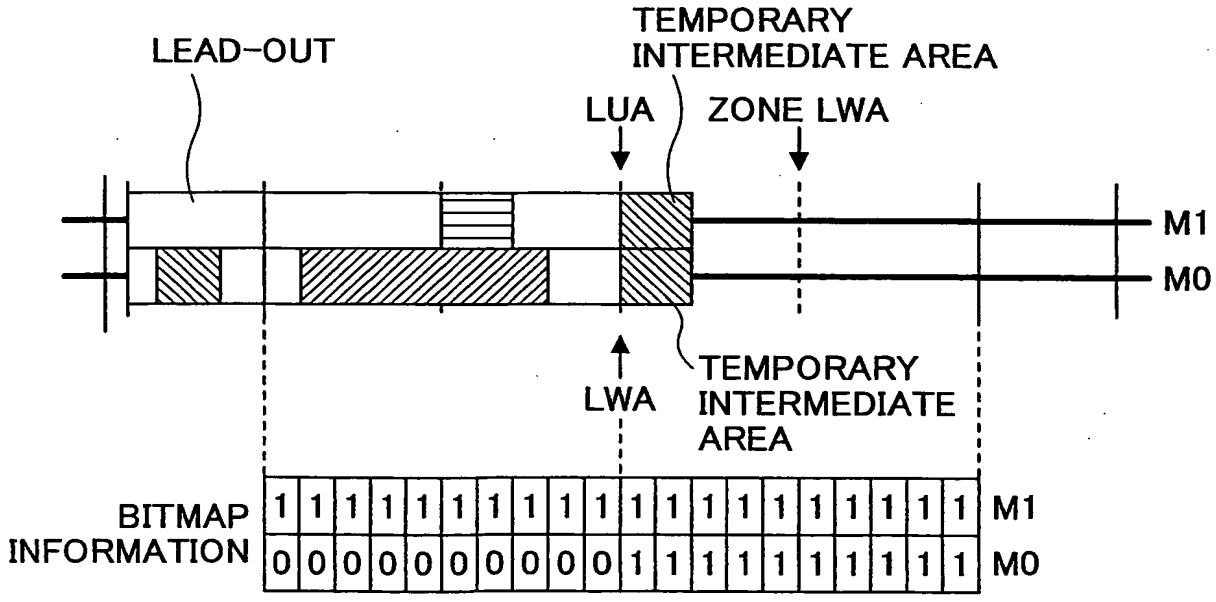


FIG.19B



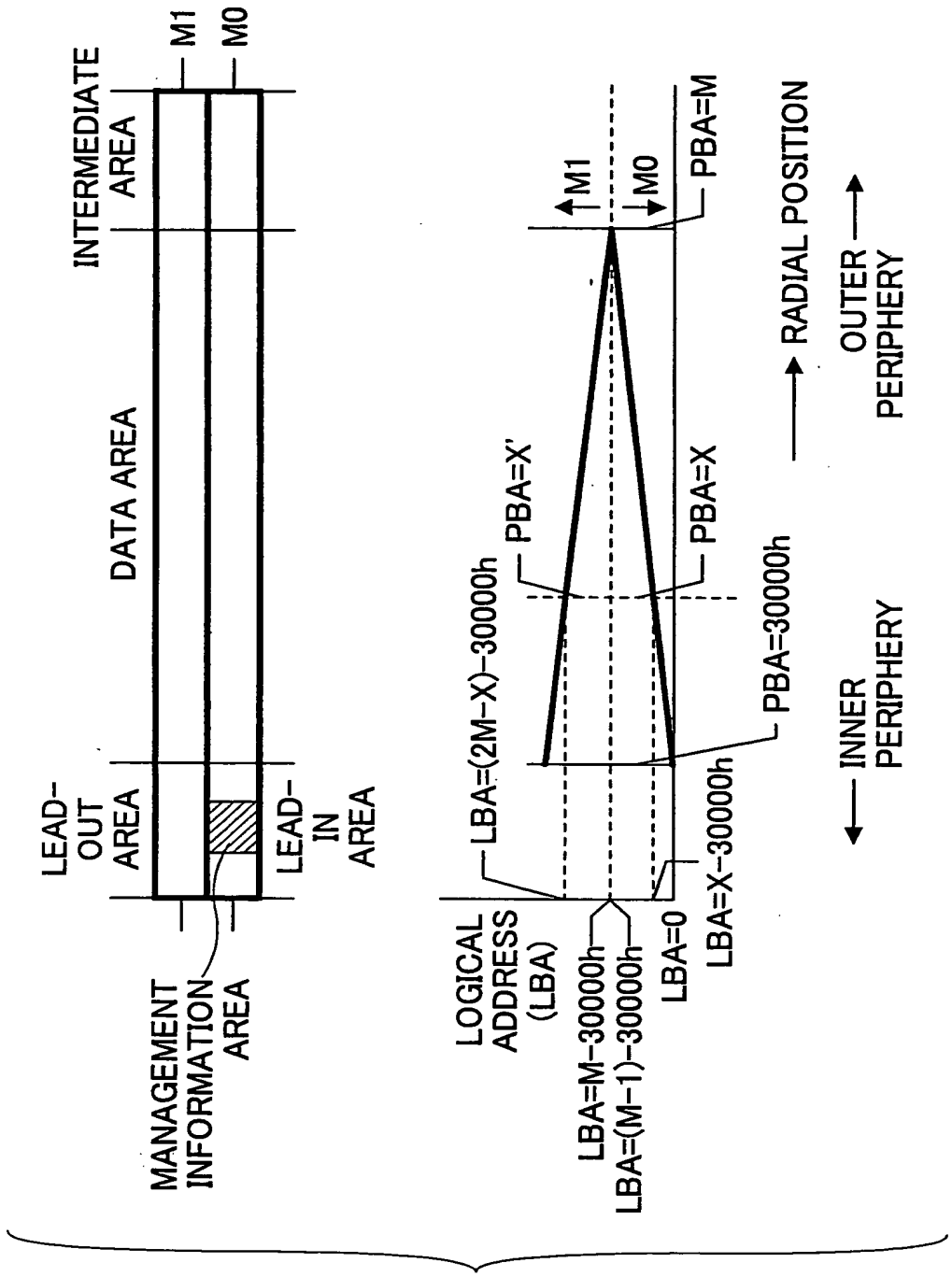

LEAD-OUT AREA
DATA AREA
INTERMEDIATE AREA
LEAD-IN AREA
M1
M0
MANAGEMENT INFORMATION AREA
LOGICAL ADDRESS (LBA)
LBA=0
LBA=M-30000h
LBA=(M-1)-30000h
LBA=(2M-X)-30000h
LBA=X-30000h
PBA=M
PBA=X'
PBA=X
PBA=30000h
RADIAL POSITION
OUTER PERIPHERY
INNER PERIPHERY

FIG.20A

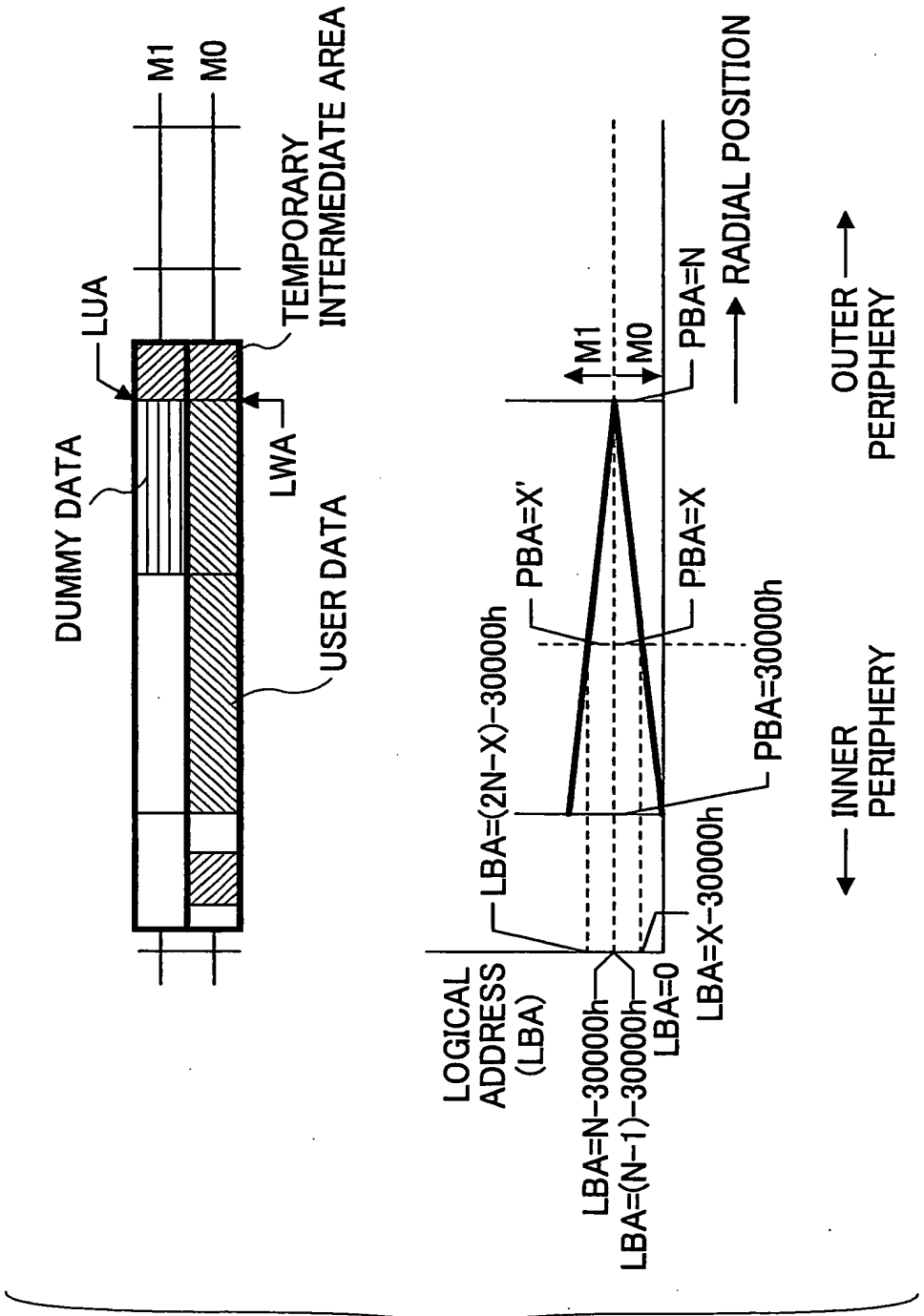

M1
M0
TEMPORARY INTERMEDIATE AREA
LUA
DUMMY DATA
LWA
USER DATA
LOGICAL ADDRESS (LBA)
LBA=N-30000h
LBA=(N-1)-30000h
LBA=0
LBA=X-30000h
LBA=(2N-X)-30000h
PBA=X'
PBA=X
PBA=30000h
PBA=N
M1
M0
RADIAL POSITION
OUTER PERIPHERY
INNER PERIPHERY

FIG.20B

FIG.21

CONTENT	BYTE NUMBER
IDENTIFICATION ID	4
RESTRICTION INFORMATION FOR UNKNOWN IDENTIFICATION ID	4
DRIVE ID	32
UPDATE COUNT	4
FORMAT STATUS	4
LAST WRITTEN ADDRESS (LWA) OF LAYER N	4
LAST VERIFIED ADDRESS (LVA) OF LAYER N	4
BITMAP START ADDRESS OF LAYER N	4
BITMAP LENGTH OF LAYER N	4
DISC ID	32
LAYER NUMBER = N(N=0,1)	1
LAST UNWRITTEN ADDRESS (LUA) OF LAYER N	4
ZONE LAST WRITTEN ADDRESS (ZONE LWA) OF LAYER N	4
RESERVATION	–
BITMAP OF LAYER N	9 × 2048
RESERVATION	–

FIG.22

CONTENT	BYTE NUMBER
IDENTIFICATION ID	4
RESTRICTION INFORMATION FOR UNKNOWN IDENTIFICATION ID	4
DRIVE ID	32
UPDATE COUNT	4
FORMAT STATUS	4
LAST WRITTEN ADDRESS (LWA)	4
LAST VERIFIED ADDRESS (LVA)	4
BITMAP START ADDRESS	4
BITMAP LENGTH	4
DISC ID	32
LAST UNWRITTEN ADDRESS (LUA)	4
ZONE LAST WRITTEN ADDRESS (ZONE LWA)	4
ZONE NUMBER	2
START ADDRESS OF ZONE 1	4
END ADDRESS OF ZONE 1	4
⋮	⋮
START ADDRESS OF ZONE m	4
END ADDRESS OF ZONE m	4
RESERVATION	–
BITMAP	9 × 2048
RESERVATION	–

FIG.23

CONTENT	BYTE NUMBER
IDENTIFICATION ID	4
RESTRICTION INFORMATION FOR UNKNOWN IDENTIFICATION ID	4
DRIVE ID	32
UPDATE COUNT	4
FORMAT STATUS	4
LAST WRITTEN ADDRESS (LWA) OF LAYER N	4
LAST VERIFIED ADDRESS (LVA) OF LAYER N	4
BITMAP START ADDRESS OF LAYER N	4
BITMAP LENGTH OF LAYER N	4
DISC ID	32
LAYER NUMBER = N(N=0,1)	1
LAST UNWRITTEN ADDRESS (LUA) OF LAYER N	4
ZONE LAST WRITTEN ADDRESS (ZONE LWA) OF LAYER N	4
ZONE NUMBER	2
START ADDRESS OF ZONE 1	4
END ADDRESS OF ZONE 1	4
⋮	⋮
START ADDRESS OF ZONE m	4
END ADDRESS OF ZONE m	4
RESERVATION	–
BITMAP OF LAYER N	9×2048
RESERVATION	–

FIG.24

CONTENT	BYTE NUMBER
IDENTIFICATION ID	4
RESTRICTION INFORMATION FOR UNKNOWN IDENTIFICATION ID	4
DRIVE ID	32
UPDATE COUNT	4
FORMAT STATUS	4
LAST WRITTEN ADDRESS (LWA) OF LAYER N	4
LAST VERIFIED ADDRESS (LVA) OF LAYER N	4
BITMAP START ADDRESS OF LAYER N	4
BITMAP LENGTH OF LAYER N	4
DISC ID	32
LAYER NUMBER = N(N=0,1)	1
LAST UNWRITTEN ADDRESS (LUA) OF LAYER N	4
ZONE NUMBER	2
START ADDRESS OF ZONE 1	4
END ADDRESS OF ZONE 1	4
ZONE LWA OF ZONE 1	4
⋮	⋮
START ADDRESS OF ZONE m	4
END ADDRESS OF ZONE m	4
ZONE LWA OF ZONE m	4
RESERVATION	–
BITMAP OF LAYER N	9 × 2048
RESERVATION	–

FIG.25A

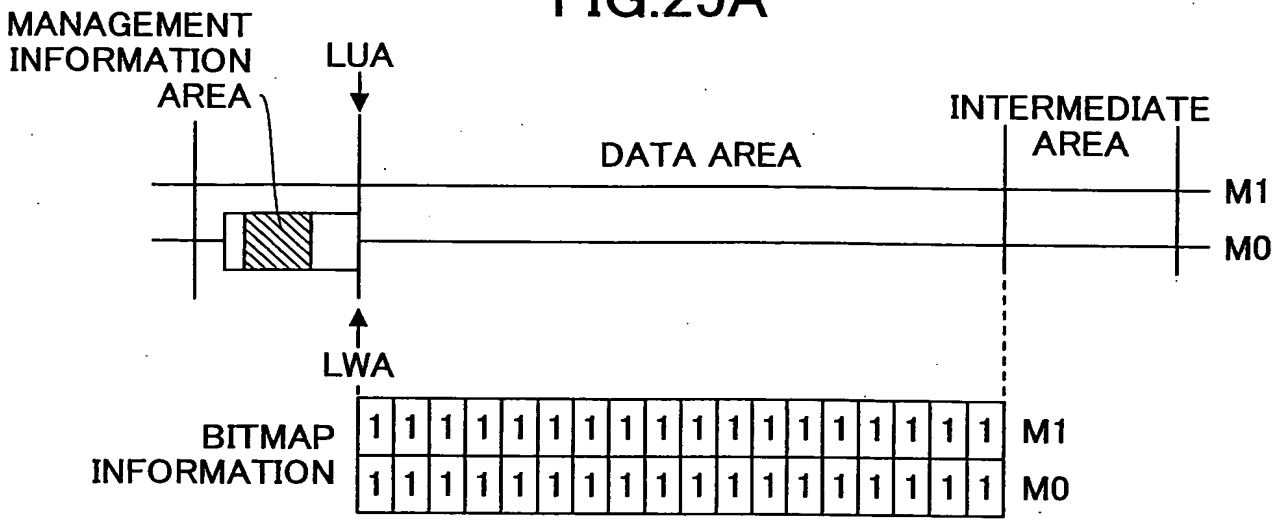


FIG.25B

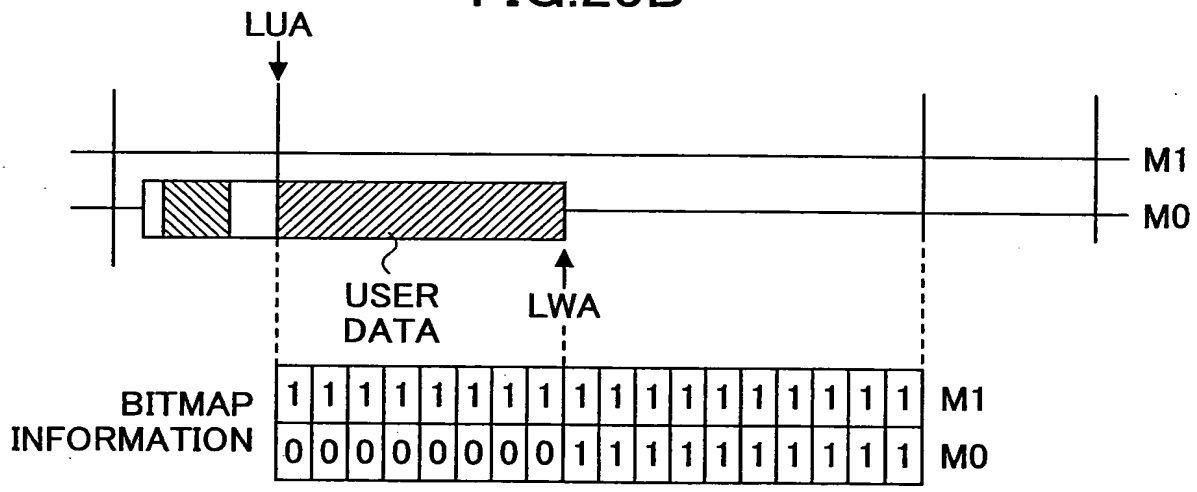


FIG.25C

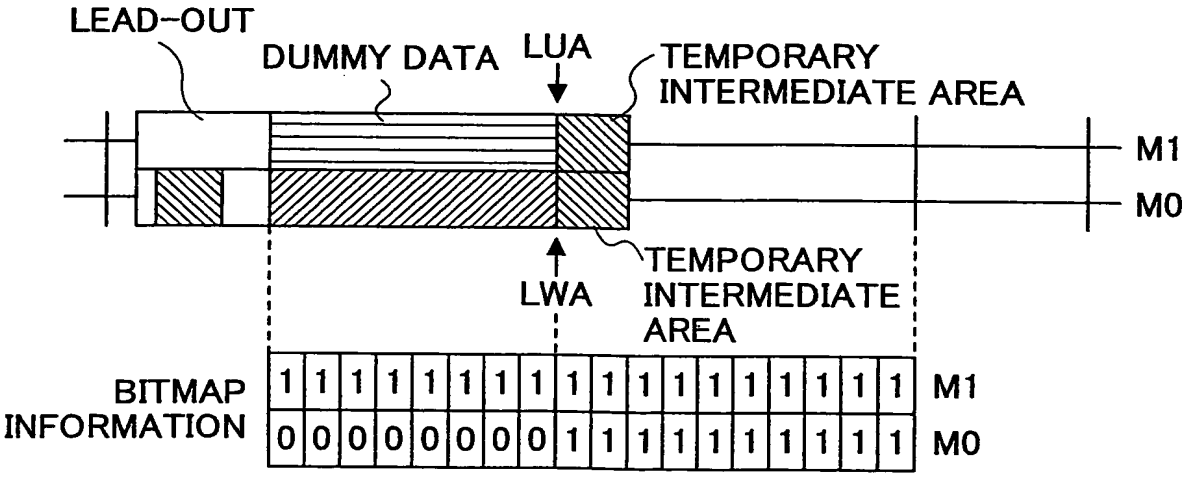


FIG.26A

CONTENT	BYTE NUMBER
IDENTIFICATION ID	4
RESTRICTION INFORMATION FOR UNKNOWN IDENTIFICATION ID	4
DRIVE ID	32
UPDATE COUNT	4
FORMAT STATUS	4
LAST WRITTEN ADDRESS (LWA)	4
LAST VERIFIED ADDRESS (LVA)	4
BITMAP START ADDRESS	4
BITMAP LENGTH	4
DISC ID	32
LAST UNWRITTEN ADDRESS (LUA)	4
RESERVATION	–
BITMAP	9 × 2048
RESERVATION	–

FIG.26B

CONTENT	BYTE NUMBER
IDENTIFICATION ID	4
RESTRICTION INFORMATION FOR UNKNOWN IDENTIFICATION ID	4
DRIVE ID	32
UPDATE COUNT	4
FORMAT STATUS	4
LAST WRITTEN ADDRESS (LWA) OF LAYER N	4
LAST VERIFIED ADDRESS (LVA) OF LAYER N	4
BITMAP START ADDRESS OF LAYER N	4
BITMAP LENGTH OF LAYER N	4
DISC ID	32
LAYER NUMBER = N(N=0,1)	1
LAST UNWRITTEN ADDRESS (LUA) OF LAYER N	4
RESERVATION	–
BITMAP OF LAYER N	9 × 2048
RESERVATION	–

FIG.27A

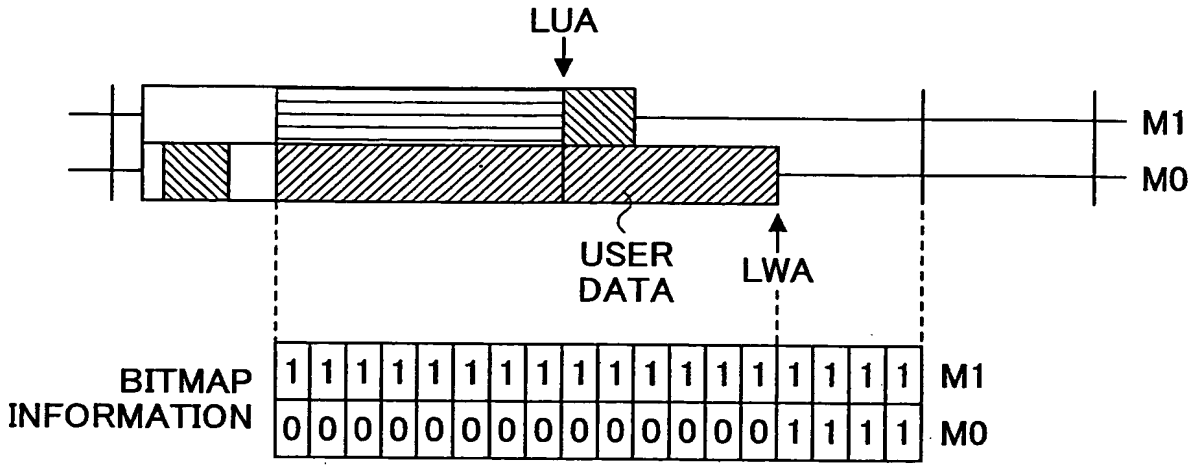


FIG.27B

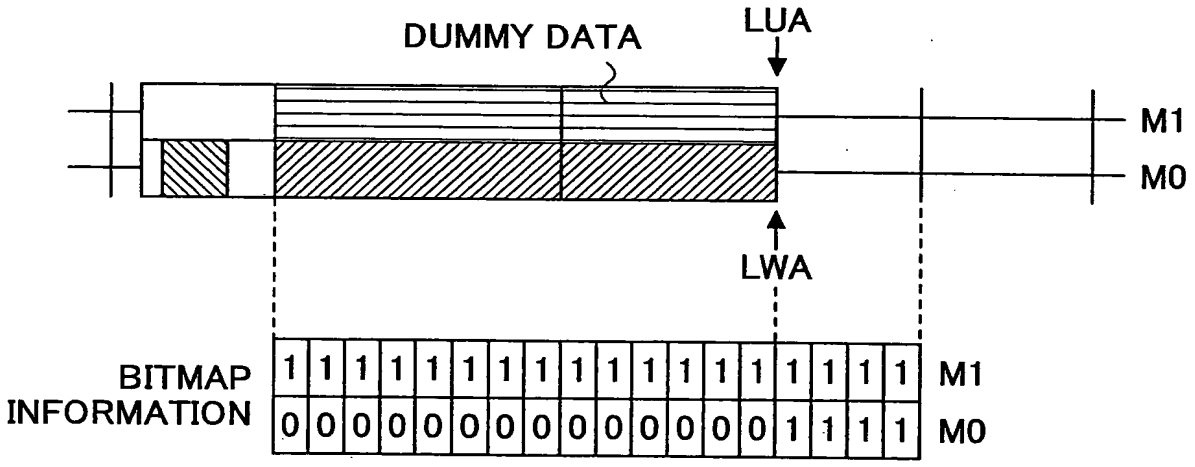


FIG.27C

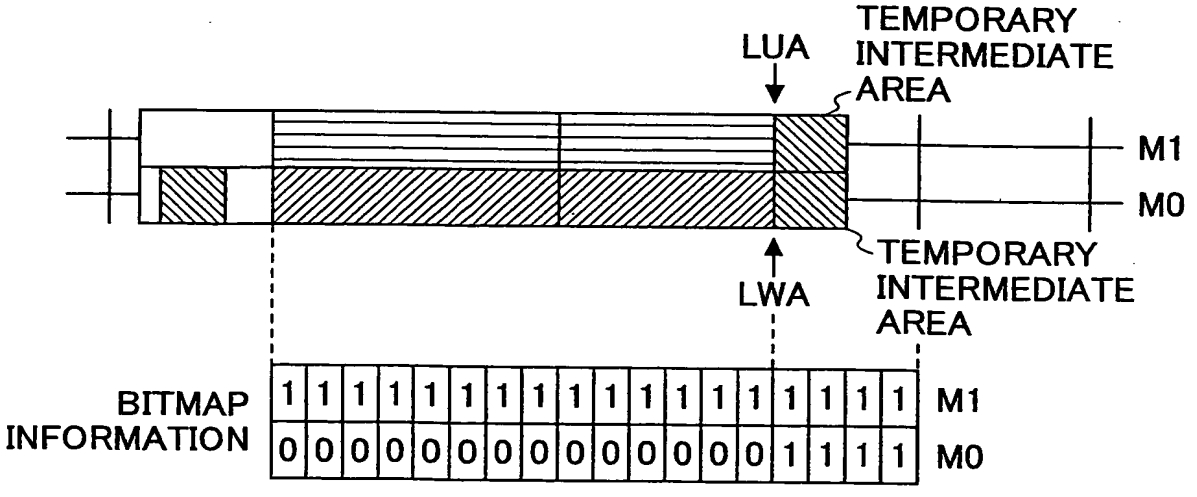


FIG.28A

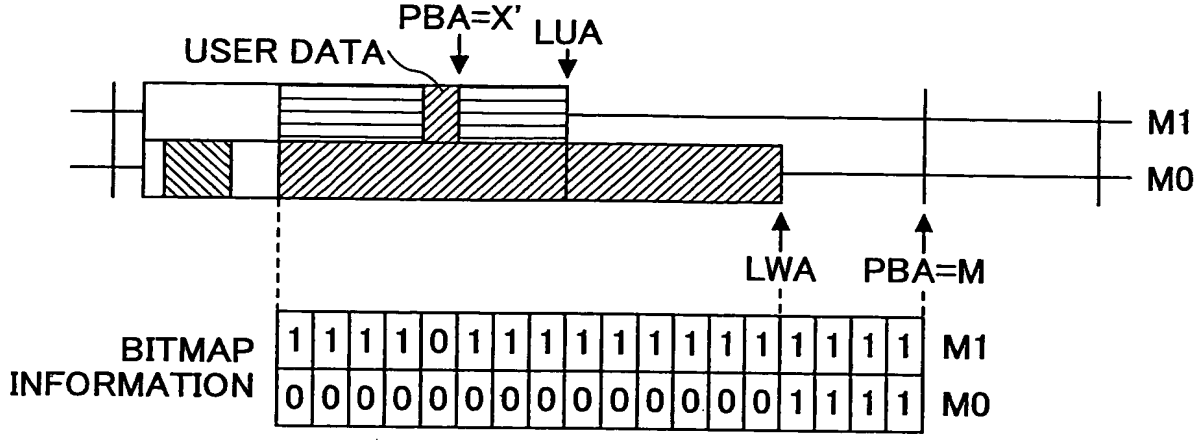


FIG.28B

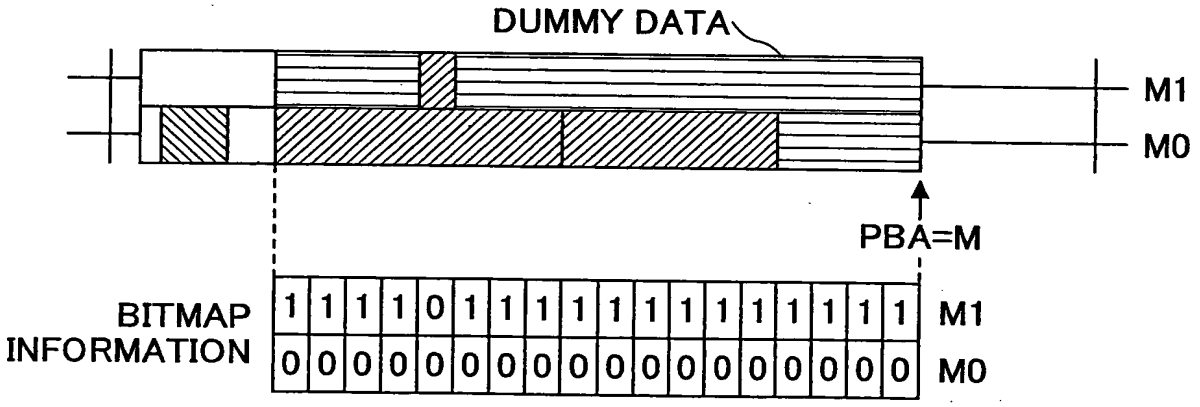
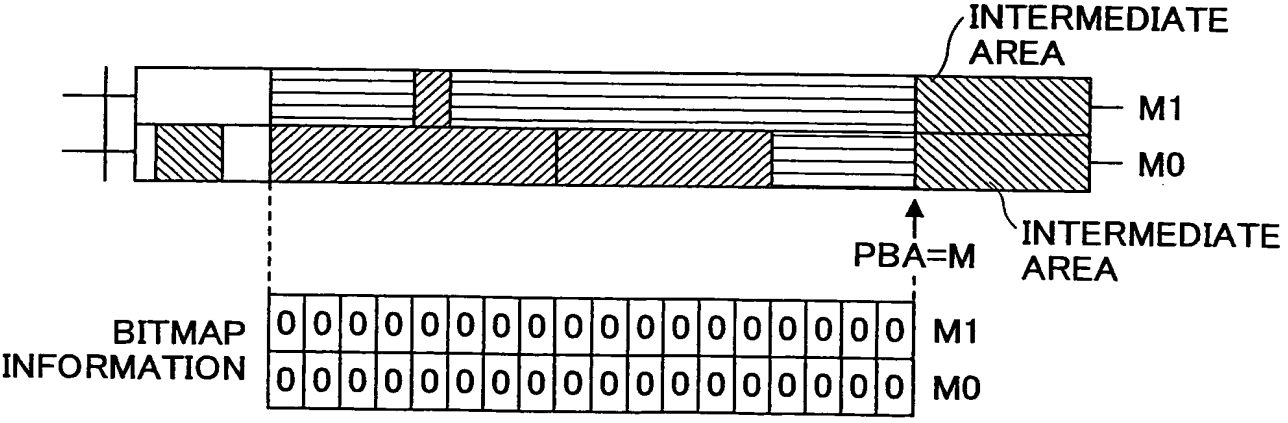



FIG.28C